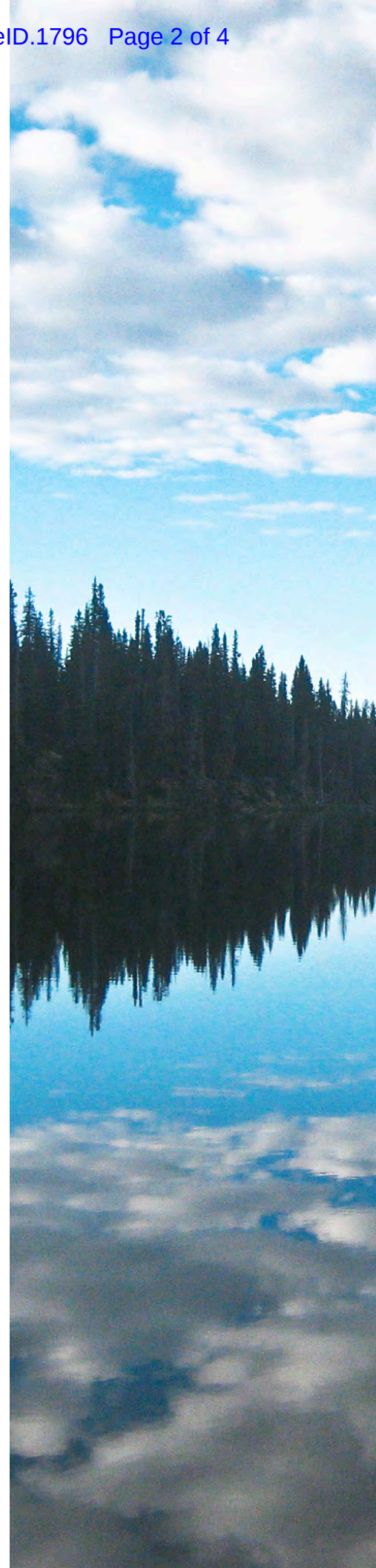


Exhibit A

AIR POLLUTION AND PUBLIC HEALTH IN UTAH



ENVIRONMENTAL
PUBLIC HEALTH TRACKING



PARTICULATE MATTER

Particulate matter (PM) is an air pollutant composed of very small particles and liquid droplets.^[1] Some particles are big enough that you can see them, such as dust or dirt. Other particles are so small that they require a strong microscope to see.^[2] PM can be made up of acids (like nitrate or sulfate), organic chemicals, metals, soil, smoke, or dust particles. The size of PM is what can determine how hazardous it can be to your health. Any particles smaller than 10 micrometers (μm) in diameter can easily pass through the nose and enter the lungs without difficulty.^[1] A micrometer, or micron, is one thousand times smaller than a millimeter and one million times smaller than a meter.^[3]

Really fine particles that are smaller than $2.5\ \mu\text{m}$ in diameter are called $\text{PM}_{2.5}$. To help understand how small this is, picture a single hair from a human head. The size of this hair is about 70 micrometers in diameter which is 30 times larger than the biggest fine particle.^[4] PM that is smaller than $10\ \mu\text{m}$ but larger than $2.5\ \mu\text{m}$ is known as PM_{10} .

The two particle sizes act different in the atmosphere. $\text{PM}_{2.5}$ can be airborne for long periods of time and travel several miles. PM_{10} , on the other hand, do not linger in the air as long and tend to land on the ground downwind from its releasing source.^[2]

Fine Particulate Matter Size Comparison



μm = micrometer

Source: Centers for Disease Control and Prevention, National Environmental Public Health Tracking Network. (2013, December 17). Health Impacts of Fine Particles in Air. Retrieved on April 22, 2015 from <http://ephtracking.cdc.gov/showAirHIA.action>

SOURCES OF PM

PM_{10} typically comes from mechanical grinding and the mixing of fluid and particles from a solid material. Examples of these are metals from suspended road dust and organic debris.^[5] They can simply be found by roadways and dusty industries.^[6] They are known as primary particles that are released directly into the air.^[2]

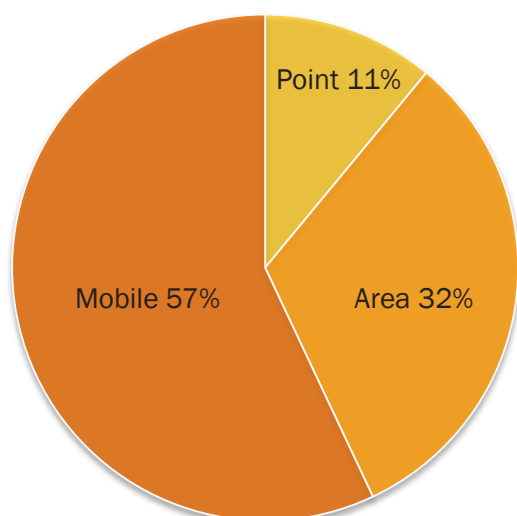
$\text{PM}_{2.5}$, also known as secondary particles, are commonly formed from combustion or photochemical reaction in the atmosphere. The reaction usually includes organic carbon, basic carbon, sulfate, nitrate, and metals.^[5] $\text{PM}_{2.5}$ can be found in smoke or haze and is released into the air from forest fires, gases from power plants, industries, vehicles, fireplaces, and wood burning stoves.^[6, 7] The particles can form from locations that are farther away from a source.^[2]

HEALTH EFFECTS OF PM

Smaller particles have more potential to trigger health problems. Those microscopic particles can go deep into the lungs and possibly enter the bloodstream.^[8] Once the particles enter the lungs, the airways become more narrow, creating more opportunity for small particles to stick to the airway walls.^[7] If small enough, the particles can reach the bloodstream via the alveoli of the lung (see Figure 1. Diagram of the Lung on page 41). Several scientific studies were able to associate PM exposure to a variety of health problems such as nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, irritation to the airways, coughing, difficulty breathing, and premature death in heart or lung cancer patients.^[8] Those who are at the highest risk to exposure of PM are people who already have heart or lung disease, children, and the elderly.

Not only does PM affect health, but it affects the environment as well. All the pollution particles in the air create haze, which is caused when sunlight touches the particles. The pollutants can absorb and scatter the sunlight reducing our visibility.^[9] Not all haze is man-made (fuel burning, motor vehicle use, etc). Wind storms and forest fires also cause haze. The wind can blow the particles over long distances where they can settle. These particles make lakes and streams acidic, change the nutrient balance in bodies of water, and damage farm crops.^[10]

Figure 1. Sources of PM_{2.5} and PM_{2.5} Precursor Gases, Wasatch Front, Utah, 2008



Source: Utah Department of Environmental Quality. (2014, April 15). Emission Sources of Winter PM_{2.5}. Retrieved on April 22, 2015 from <http://www.deq.utah.gov/FactSheets/fspages/sources.htm>

Figure 1.

This chart shows the sources of PM_{2.5} and its precursor gases on a typical winter day along the Wasatch Front (consisting of Weber, Davis, Salt Lake, and Utah counties). Precursor gases are pollutants that chemically react in the atmosphere and end up forming PM_{2.5}. The precursor gases included in this graph are NO_x, SO_x, and VOCs. *Mobile* sources refer to highway automobile and trucks, locomotives, and aircraft. *Point* sources refer to facilities that release large amounts of air pollution. This includes sources such as power plants, industrial manufacturing, and heating. *Area* sources are similar to point sources, but they are too small and numerous to be considered separately. Area sources include small industries, residential heating, gas stations, pesticides, and dry cleaners. As this graph shows, the majority of PM_{2.5} and PM_{2.5} precursor gases come from mobile sources.